SUBSTITUTE SPECIFICATION

[001]MACHINE TOOL GEAR TRANSMISSION

[002] This application is a national stage completion of PCT/EP2004/010886 filed September 29, 2004 which claims priority from German Patent Application Serial No. 103 48 755.7 filed October 21, 2003.

[003] FIELD OF THE INVENTION

[004] The present invention refers to a machine tool transmission, in particular to a spindle transmission.

[005] BACKGROUND OF THE INVENTION

[006] The current state of the art is transmissions that usually include a two level planetary transmission and corresponding switchgear arranged in a parallel axle to the spindle, whereby the power transfer to the spindle takes place through bands or gears. The use of gears for power transfer requires a high drive torque that endures the tensile strength and pretensed bands as well as a wide bearings foundation for the wide dimensioned belt pulleys. These will be further needed in the transmission drive cylinder roller bearings or similar ball bearings in which the belt force is high. However, larger ball bearings are used in unfavorable ways in limited applications of high rotational speeds. The ball bearings naturally show a radial slackness which results in an unbalanced and vibrating behavior in the planet carrier of the transmission. When a gear wheel transmission is used, additional axial forces exist in those gear wheels with beveled gearing in the transmission drive, which must also be absorbed. This solution shows the further disadvantage that as a result of the force transfer between the transmission and the spindle, the general noise level is too high.

[007] SUMMARY OF THE INVENTION

[008] The present invention tackles this problem in a machine tool transmission, in particular in a specific spindle transmission with which the mentioned state of the art disadvantage is avoided. In particular, the noise level of the transmission

will be reduced by applying the invention; also any undesired vibration will be largely avoided.

[009] In addition, the production costs will be reduced and the required space will be optimized.

[010]

[011] According to this, a spindle transmission will be proposed in which the force and torque transfer from the transmission drive shaft to the spindle takes place directly, whereby the spindle is preferably arranged coaxially with the drive shaft.

[012] Hereby the transmission drive shaft is directly connected with the spindle; the torque proof connection between the spindle and the drive shaft can take place from-closing or spring actuated. A connecting element can also be used between the spindle and the drive shaft.

[013] According to a particularly beneficial embodiment of the invention, a drive shaft mounted over a short bearings housing, which the spindle drives. This results in the benefit that the entire length of the transmission is noticeably reduced.

[014] The invention is suitable for mounting drive shafts over almost slack-free bearings, like for example beveled ball bearings, with which the torque may be transferred without vibrations to the spindle.

[015] Through an invention-based conception, the need for a belt or toothed gear drive for the spindle is avoided, so that the vibration and noise caused, the temperature increase caused by the belt friction, and the construction dependent rotational speed limitation, may be avoided. A significant cost reduction may be further obtained through eliminating the belts, the belt pulleys or gears; for example, no additional gear lubrication or cooling is necessary in the drive.

[016] Another benefit of the invention that can be mentioned is the significant oil loss reduction between the bearings, as a minimal oil quantity is required in this area.

[017] In a convenient way, the drive requires no maintenance; in the current state of the art, transmissions require that the belts are either tensed or replaced. Furthermore, direct torque transfer eliminates false belts pretension force adjustments that may lead to damage the spindle bearings and to cause belt

slippage as well. The spindle bearings useful life will be increased, as no shearing force will be effected over the spindle bearings by the belts, gears tangential and axial forces.

[018] According to the invention, all the transmission components will be placed in a housing which makes the operation independent from any external influence. (For example, cooling fluid mist from the belts drive may cause belt slipping). Placing the components inside a housing increases the work safety, and there will be no free-spinning components in hand.

[019] BRIEF DESCRIPTION OF THE DRAWING

[020] The invention will be explained in further detail by means of the attached Fig., which consists of a schematic sectional view of a convenient embodiment of a transmission designed according to the present invention.

[021] DETAILED DESCRIPTION OF THE INVENTION

[022] It shows the planetary gear of a machine tool transmission, specifically in a spindle transmission with which the operator is familiar with, like the EP 1 169 582 B1 model of the applicant. A wide range of types of transmissions may be implemented.

[023] The Fig. shows a spindle transmission 1, which includes a drive shaft 2, a pinion shaft 3 and a two-level planetary gear located in the force flow between the drive shaft and the pinion shaft. The planetary gear shows a sun gear 4 connected with the drive shaft, a hollow gear 5 mounted on bearings 6 and a planetary carrier 7 with planet 8, which form the output of the planetary gear.

[024] The sliding sleeve 9, selector fork 10 and braking disc 11 are intended for shifting the transmission; the shifting unit includes solenoid 12, which actuates gearshift 13 that is connected the selector fork 10. Hereby the sliding sleeve can be taken to a neutral position, to a first position in which the hollow gear 5 is coupled with the transmission housing 14 and a second position can be selected, in which the hollow gear 5 is connected with the sun gear 4.

[025] The pinion shaft 3 will be mounted in the bearings housing 15 over the beveled ball bearings 16 and 17; therefore the torque may be transferred free of

vibrations from the pinion shaft 3 to the spindle, making possible a direct connection of the pinion shaft 3 with the spindle and in consequence a coaxial and space-saving arrangement.

[026] It is evident in each constructive development, in particular in each spatial configuration of the transmission components, that the shifting system and the shifting unit are technically significant to each other, under the scope of protection of the present claims without the transmission functions, as it is quoted in the claims, to influence also when these developments may not be explicit enough in the Fig. or in the above given description.

Reference signs

1	Machine tool transmission
2	Drive shaft
3	Pinion shaft
4	Sun gear
5	Hollow gear
6	Hollow gear bearings
7	Planetary gear
8	Planet
9	Sliding sleeve
10	Selector fork
11	Braking disc
12	Solenoid
13	Shifting level
14	Transmission housing
15	Bearings housing
16	Beveled ball bearing
17	Beveled ball bearing